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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/604,594	08/01/2003	Hiroyuki Akatsu	FIS920030200US1	1593

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EXAMINER	
NGUYEN, KHIEM D	

ART UNIT	PAPER NUMBER
2823	

DATE MAILED: 08/04/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/604,594	HIROYUKI AKATSU	
	Examiner	Art Unit	
	Khiem D Nguyen	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *01 August 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) *18-20* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-17* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *01 August 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *080103* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Election/Restrictions

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:

I. Claims 1-17, drawn to a method of making a trench capacitor, classified in class 438, subclass 386.

II. Claims 18-20, drawn to an integrated circuit including a deep trench structure formed in a single-crystal region of a semiconductor substrate, classified in class 257, subclass 301.

2. The inventions are distinct, each from the other because of the following reasons: Inventions II and I are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case, the product as claimed can be made by another and materially different process such as one in which the process of making a trench capacitor having a round shape lower trench portion instead.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

During a telephone conversation with Attorney H. Daniel Schurmann on 07/13/04 a provisional election was made without traverse to prosecute the invention of Group I, claims 1-17. Affirmation of this election must be made by applicant in replying to this

Office action. Claims 18-20 withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-2 and 4-15 are rejected under 35 U.S.C. 102(b) as being anticipated by Kudelka et al. (U.S. Patent 6,426,254).

In re claim 1, **Kudelka** discloses a method of making a trench capacitor comprising: forming a trench **110** in a substrate **102**, widening the trench (col. 4, lines 29-46 and **FIGS. 1-17**); forming a sacrificial collar **116** on sidewalls of the widened trench; vertically deepening the trench to extend below the sacrificial collar **(FIG. 8)**; and forming a capacitor (col. 7, lines 4-16 and **FIGS. 11-12**) in the trench below the sacrificial collar.

In re claim 2, **Kudelka** discloses wherein the method of Claim 1 further comprising forming a pad stack **101** on the substrate **102**, forming a hard mask **108** over

the pad stack **101**, and patterning the hard mask and the pad stack to form an opening therein, wherein the trench **110** is formed by etching the substrate through the opening (col. 4, lines 6-27).

In re claim 4, **Kudelka** discloses wherein the trench 110 is formed by anisotropic etching (col. 4, lines 24-27 and **FIGS. 1-8**).

In re claim 5, **Kudelka** discloses wherein the trench **110** is widened by isotropic etching using a chemistry selected from the group consisting of dry plasma process, wet silicon etch process, and an HNO_3 /HF mixture (col. 4, lines 29-47, col. 5, line 61 to col. 6, line 12, and **FIG. 8**).

In re claim 6, **Kudelka** discloses wherein the trench is widened by anisotropic etching using a chemistry selected from the group consisting of wet alkaline chemistry and NH_4OH (col. 4, lines 29-47, col. 5, line 61 to col. 6, line 12, and **FIG. 8**).

In re claim 7, **Kudelka** discloses wherein the trench is deepened by anisotropic etching (col. 4, lines 24-27 and **FIGS. 1-8**).

In re claim 8, **Kudelka** discloses wherein the sacrificial collar 116 includes an underlayer of oxide and a top layer of nitride (col. 4, line 53 to col. 3 and **FIGS. 1-8**).

In re clam 9, **Kudelka** discloses wherein the sacrificial collar comprises a layer of nitride (col. 4, line 53 to col. 5, line 3 and **FIGS. 1-8**).

In re claim 10, **Kudelka** discloses a method of providing a trench capacitor on a semiconductor substrate **102**, comprising: forming a pad stack **101** on a semiconductor substrate, forming a hard mask **108** over the pad stack, patterning the hard mask **108** and the pad stack **101** to form an opening; vertically etching the substrate in he opening to

form a trench **110**; horizontally widening sidewalls of the trench to widen an opening of the trench (col. 4, lines 29-46 and **FIGS. 1-17**); forming a sacrificial collar **116** on the widened sidewalls; vertically deepening the trench to create a lower portion **125** extending below the sacrificial collar **116**; and forming a capacitor in the lower portion (col. 7, lines 4-16 and **FIGS. 8-12**).

In re claim 11, **Kudelka** discloses wherein the pad stack **101** comprises a pad nitride layer **106** overlaying a pad stop layer including an oxide **104** (col. 4, lines 6-27 and **FIGS. 1-8**).

In re claim 12, **Kudelka** discloses wherein the hard mask **108** comprises an oxide layer selected from the group consisting of a tetraethylorthosilicate (TEOS) deposited oxide layer and a borosilicate glass (BSG) deposited oxide layer (col. 4, lines 53 to col. 5, line 3 and **FIGS. 1-8**).

In re clam 13, **Kudelka** discloses wherein the sacrificial collar comprises a layer of nitride (col. 4, line 53 to col. 3 and **FIGS. 1-8**).

In re claim 14, **Kudelka** discloses wherein the sacrificial collar 116 further comprises a layer of oxide contacting the widened sidewalls under the layer of nitride (col. 4, line 53 to col. 5, line 3 and **FIGS. 1-8**).

In re claim 15, **Kudelka** discloses wherein the method of Claim 10 further comprising widening the lower portion **125** by an isotropic etch to achieve a bottle-shaped structure prior to forming the capacitor (col. 4, lines 29-47, col. 5, line 61 to col. 6, line 12, and **FIG. 8**).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 3, 16, and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kudelka et al. (U.S. Patent 6,426,254) in view of Birner et al. (U.S. Patent 6,660,582).

In re claim 3, **Kudelka et al.** do not explicitly disclose wherein the method of claim 2 further comprising selectively widening sidewalls of the opening in the pad stack such that the hard mask overhangs sidewalls of the opening in the pad stack.

Birner et al., however, disclose selectively widening sidewalls of the opening **102** in the pad stack such that the hard mask **100** overhangs sidewalls of the opening **102** in the pad stack (col. 8, lines 10-32 and **FIGS. 1-4**). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to combine the teaching of Kudelka and Birner to enable the hard mask of Kudelka that overhangs the sidewalls of the opening in the pad stack to be formed and furthermore undesired instances of contacting of neighboring components of highly integrated circuits can be prevented in a simple way (col. 1, lines 60-62, Birner).

In re claim 16, **Kudelka et al.** do not explicitly disclose wherein the method of Claim 10 further comprising widening the opening in the pad stack selective to the hard mask prior to vertically deepening the trench such that sidewalls of the hardmask

overhang the sacrificial collar and protect the sacrificial collar while deepening the trench.

Birner et al., however, disclose widening the opening **102** in the pad stack selective to the hard mask **100** prior to vertically deepening the trench **(FIG. 4)** such that sidewalls of the hardmask overhang the sacrificial collar 61 and protect the sacrificial collar while deepening the trench (col. 8, lines 10-53 and **FIGS. 1-7**). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to combine the teaching of Kudelka and Birner so that undesired instances of contacting of neighboring components of highly integrated circuits can be prevented in a simple way (col. 1, lines 60-62, Birner).

In re clam 17, **Kudelka et al.** do not explicitly disclose wherein the opening in the pad stack is widened at the same time that the sidewalls of the trench are horizontally widened.

Birner et al., however disclose wherein the opening 102 in the pad stack is widened at the same time that the sidewalls of the trench are horizontally widened (col. 8, lines 10-32 and **FIGS. 1-4**). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to combine the teaching of Kudelka and Birner so that undesired instances of contacting of neighboring components of highly integrated circuits can be prevented in a simple way (col. 1, lines 60-62, Birner).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Khiem D Nguyen whose telephone number is (571) 272-1865. The examiner can normally be reached on Monday-Friday (8:00 AM - 5:00 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on (571) 272-1855. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 305-3432 for regular communications and (703) 305-3432 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

K.N.
July 30, 2004

W. DAVID COLEMAN
PRIMARY EXAMINER